

APPLICATION

FOR

UNITED STATES LETTERS PATENT

TITLE: **PROCESSING RELATIVELY THIN**
 GLASS SHEETS

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PROCESSING RELATIVELY THIN GLASS SHEETS

Background

This invention relates generally to handling relatively thin glass sheets.

5 Thin glass sheets may be utilized for example in connection with displays for electronic devices. For example, in connection with organic light emitting device (OLED) displays, thin glass sheets may act as the front panel of a display. In some cases, OLED materials may be
10 deposited, together with row and column electrodes, on the thin glass sheet.

In making large displays, a number of display tiles may be formed with such front panels. Those tiles are abutted one against the other. By abutting a large number
15 of such tiles, a relatively large display may be formed.

The display formed in this fashion may be advantageous for a number of reasons including the fact that large displays need not be made from a single substrate. Generally because of the possibility of defects, the larger
20 the substrate that is needed to form the display, the lower the yield per device and the higher the expense per device. By using smaller substrates, which may in turn have a lower chance of defects per wafer, the loss due to defects may be dramatically reduced. By simple probability, a larger

wafer would be more likely to have a defect than a similarly designed smaller substrate.

When the individual tiles are butted one against another, seams result. These seams may be visible to the user of the display. In many cases the seams are a distraction and are considered a negative in connection with large displays.

Therefore, it would be desirable to reduce the prominence of seams in such displays. The ability to perceive the seam is a function of how thick is the glass utilized in the front panel. Generally, the thicker the glass, the more easily visible, from some angles, is the seam.

Therefore, it would be desirable to use relatively thin glass in connection with displays as well as other applications. Processing equipment is used to process the glass to fabricate features on the glass, such as the OLED material, the row electrodes, and the column electrodes. Conventional processing equipment is designed for a certain glass thickness. Manufacturing with thinner glass may require special equipment development. This generally may mean that the use of thinner glass may result in a manufacturing cost penalty. If thinner glass could be handled by existing equipment, then there would be a benefit to the display industry and to other industries that use relatively thin glass.

Thus, there is a need for a way to enable easier handling of relatively thin glass sheets.

Brief Description of the Drawings

Figure 1 is a front elevational view of one embodiment
5 of the present invention;

Figure 2 is a front elevational view of glass sheets being charged in accordance with one embodiment of the present invention;

10 Figures 3a through 3c are partial, enlarged, cross-sectional views of the processing of a composite sheet in accordance with one embodiment of the present invention;

Figure 4 is a front elevational view of the glass sheets shown in Figure 2, having been combined, about to be separated in accordance with one embodiment of the present
15 invention; and

Figure 5 is a top plan view of a technique for separating the electrostatically joined sheets in accordance with one embodiment of the present invention.

Detailed Description

20 Referring to Figure 1, a pair of glass sheets 10 and 12 may be electrostatically charged. One of the sheets, such as the sheet 12, may be relatively thinner than the thickness that is most desirable in connection with conventional glass processing equipment. For example,
25 equipment normally utilized to process electronic display

panels may be standardized to particular thicknesses. The thickness of a glass sheet 12 may be less than the thickness of glass for which such equipment is designed.

In many applications, relatively thin glass sheets may be more difficult to process than thicker glass sheets. While an embodiment is described herein in connection with the glass for a display panel such as an organic light emitting device (OLED) display, it will be appreciated that many other applications may be implemented with embodiments of the present invention as well.

Initially, a pair of glass sheets 10 and 12 may be thoroughly cleaned as indicated by the arrows A. In one embodiment, the sheets 10 and 12 may be exposed to a liquid cleaner and then dried.

Referring to Figure 2, each sheet 10 and 12 may then be subjected to electrostatic charges of opposite polarities in one embodiment. In one embodiment, a charge source 14 may be utilized to apply a positive charge to a grounded sheet 10. For example, the charge source 14 may be a corona source. Similarly, a negative potential is applied by a charge source 16 to the sheet 12 which is also grounded. The charge source 16 may also be a corona source in one embodiment.

The grounding of a sheet 10 or 12 may be accomplished through a conductive coating on one side of a sheet 10 or 12. Alternatively, a sheet 10 or 12 may be grounded by

putting it against a ground plate. In some embodiments, it may be preferable to ground a sheet, charge the sheet and then put charged surfaces in contact and thereafter remove the ground, if necessary.

5 Once the sheets 10 and 12 are oppositely charged, electrostatic attraction holds the sheets 10 and 12 together as shown in Figure 3. After the sheets 10 and 12 are put together, the sheet 12 may be processed as part of a composite sheet 18 in the conventional fashion. In some
10 cases, the charge may be positioned on opposed outside surfaces of sheets to be joined. In other cases, the charge may be placed on opposed inside surfaces or adjacent surfaces of sheets to be joined. As still another possibility, charge may be placed on the outside surface of
15 one sheet to be joined and on the inside surface or facing surface of another sheet to be joined. In many cases, placing the charge on facing surfaces may be most advantageous.

 In some embodiments, standard processing equipment may
20 be utilized. The standard equipment may be utilized because the thickness of the combined sheet 18 is in accordance with the specifications of that equipment. Thus, the composite sheet 18 may be processed by applying material to the surface of the sheet 12. Such materials,
25 in some embodiments, may include the deposition of row and column electrodes, and organic light emitting materials.

In accordance with one embodiment of the present invention, the combined sheets 10 and 12 may be processed to form a light emitting display. Thus, the sheet 10 acts as a carrier and processing steps are applied to the sheet 12. As shown in Figure 3a initially, transparent column electrodes may be formed on the surface of the sheet 12. In one embodiment, the column electrodes are transparent conductive material such as indium tin oxide (ITO). Thereafter, an organic light emitting material 32 may be deposited to form light emitting elements of a display as shown in Figure 3b. An insulating material 36 may be applied and the resulting structure covered with the deposited row electrodes 34. In one embodiment, the row electrodes 34 may extend transversely to the column electrodes 30, as shown in Figure 3c. The row electrodes 34 in one embodiment may be made of a metal such as aluminum.

Once the processing of the sheet 12 is completed, the combined sheets 18 may be separated. A wedge 24 may be driven between the two sheets 10 and 12, as indicated in Figure 4, to begin to peel the sheets 10 and 12 from one another, for example at a corner.

Once the wedge is inserted between the sheets 10 and 12, as shown in Figure 5, fluid (gas or liquid) sprays may be utilized to continue to peel the two sheets 10 and 12 apart. For example, an air or water spray gun 20 may be

used to direct a spray of fluid indicated at B at the partially separated corner region.

Before separation is initiated and/or once the separation is initiated, in some embodiments, a charged gas stream C may be applied from ionized air guns 22. The guns 22 may reduce the charge on the sheets 12 and 10 making up the composite 18.

By using the spray gun 20, the two sheets 10 and 12 may be progressively peeled apart. The carrier sheet 10 may then be reused to carry another sheet 12 processing. The sheet 12 may then be applied in its intended application such as to act as the front panel of an electronic display.

The amount of surface voltage needed will depend on substrate thicknesses. Suitable voltages for substrates of .5 millimeters thicknesses are from 500 to 1000 volts in some embodiments. It may be desirable to apply charges of the same magnitude but of opposite polarity to each of the sheets 10 and 12. When sheets, charged to a similar potential of opposite polarity, are electrostatically combined, the net charge on the composite 18 is about zero. Substantial electrical neutrality may reduce the attraction of dust to the composite 18 during processing.

While the present invention has been described with respect to a limited number of embodiments, those skilled in the art will appreciate numerous modifications and

variations therefrom. It is intended that the appended claims cover all such modifications and variations as fall within the true spirit and scope of this present invention.

What is claimed is: